

# Eliminating Adverse Impacts of Low Dissolved Oxygen in the Sound

The Long Island Sound Study identified low dissolved oxygen (hypoxia) as the most significant water quality problem in LIS affecting critical life cycles of living marine resources. Since 1990, EPA and the states of Connecticut and New York have implemented a phased program to reduce human-caused nitrogen loads to LIS and improve dissolved oxygen levels to meet water quality standards.

## **CCMP Strategy:**

The CCMP identifies a five part strategy to address the elimination of adverse impacts of low dissolved oxygen on the aquatic habitat and living marine resources of the Sound: 1) reducing nitrogen from sewage treatment plants (STPs) and other point sources; 2) reducing nitrogen loads from nonpoint sources; 3) continuing the management of hypoxia; 4) funding implementation of hypoxia management plans; and 5) monitoring and assessing hypoxic conditions in the Sound.

## **Environmental Indicators/Results/Trends**

Total point source nitrogen loads to the Sound have declined significantly over the last 10 years as STPs implement more stringent nitrogen controls. The areal extent and duration of hypoxia have also declined since the late 1980s, but summer hypoxia is still a significant impairment to water quality and continues to affect critical life cycles of living marine resources. Nitrogen loads to LIS from nonpoint sources have also declined over the last 10 years. Developing the ability to directly link declining nitrogen loads to water quality improvements and to changes in living marine resource juvenile recruitment and survival rates is an ongoing challenge and goal of the program.

## **2001 Highlights:**

- The states of New York and Connecticut completed and EPA approved the nitrogen Total Maximum Daily Load (TMDL) in 2001. The TMDL is consistent with the July 1998 ***Phase III Actions for Hypoxia Management***, the LISS bi-state agreement establishing a 58.5 percent reduction in nitrogen loads to the Sound over a fifteen year period ending in 2014.
- New York City entered into an historic Consent Agreement with the state of New York and EPA to upgrade its four upper East River STPs for nitrogen control and upgrade secondary treatment at the Newtown Creek facility. The City will invest \$1.4 billion in capital improvements at these facilities over the next five years, reducing the nitrogen load to LIS from these NY sources.
- Connecticut proposed a General Permit for Nitrogen Discharges in 2001 and formally adopted it on January 1, 2002. Under Connecticut Public Act 01-180, the state established a Nitrogen Credit Exchange program that allows participating municipal STPs to trade nitrogen credits to meet water quality standards, saving funds that would otherwise be necessary for capital upgrades for nitrogen control at all plants.
- The estimated nitrogen load from STPs in the LIS drainage basin that entered the LIS in 2001 is approximately 152,645 lbs/day, a decrease of more than 59,000 lbs/day from base year levels. This significant level of effort has been voluntarily achieved by the states and municipalities over the last ten years by cooperating for the benefit of the environment in anticipation of the adoption of enforceable nitrogen TMDL permit limits.
- As of December 2001, New York's 2001 point source nitrogen load was 111,413 lbs/day, compared with 109,518 lbs/day in 2000. As of December 2001, Connecticut's 2001 point source nitrogen loading was 41,232 lbs/day compared with 46,951 lbs/day in 2000. Figure 1 shows the total

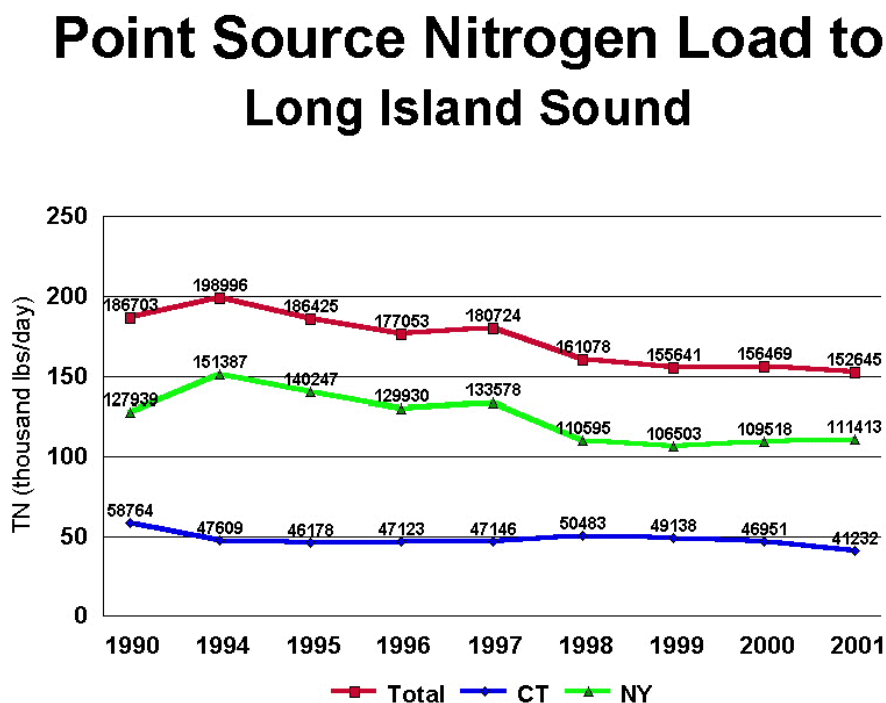
point source nitrogen load and trends in New York and Connecticut since 1990.

- In 2001, the maximum area and duration of dissolved oxygen (DO) levels less than 3 mg/l observed in LIS was 133 mi<sup>2</sup> and 66 days. The fifteen year averages are 201 mi<sup>2</sup> and 56 days. Hypoxic conditions began on or about July 10 and lasted somewhat longer than average in 2001, ending around September 14. Figure 2 shows the timing and duration of hypoxia in LIS since 1987. Figure 3 shows the areal extent of hypoxic conditions during August 2001.
- In 2001 the USGS New York District completed and published a report presenting estimates of nitrogen loads entering Long Island Sound from surface water and ground water discharging from

Long Island: ***Estimates of Nitrogen Loads Entering Long Island Sound from Ground Water and Streams on Long Island, New York, 1985-96;*** USGS Water-Resources Investigations Report 00-4196, Scorca, M. P. and Monti, J..

- In January 2001, the Westchester County Department of Planning, with six municipalities under the auspices of Watershed Advisory Committee 4, completed ***Controlling Polluted Stormwater: A Management Plan for the Sheldrake and Mamaroneck Rivers and Mamaroneck Harbor.*** The plan recommends actions to control nonpoint source pollution through municipal ordinances and comprehensive plans, streams and wetlands stormwater management, and public outreach and education.

Figure 1



These estimates include 98 municipal, 4 state, 3 private, and 4 industrial discharges = 109  
 FY2001 data includes: NY as of June 2001; CT as of December 2001

# Timing and Duration of Hypoxia in Long Island Sound

1987-1990 University of Connecticut  
1991-2000 Connecticut Department of Environmental Protection

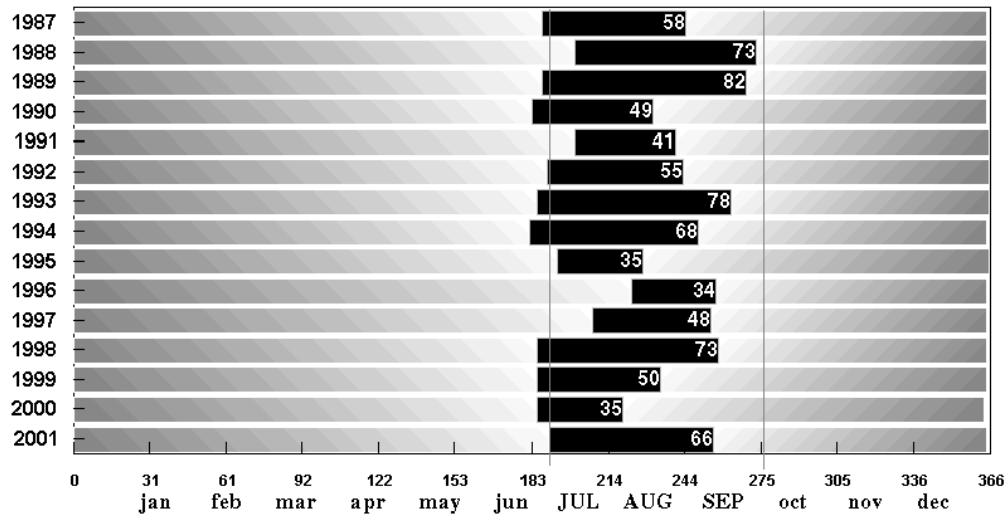


Figure 2

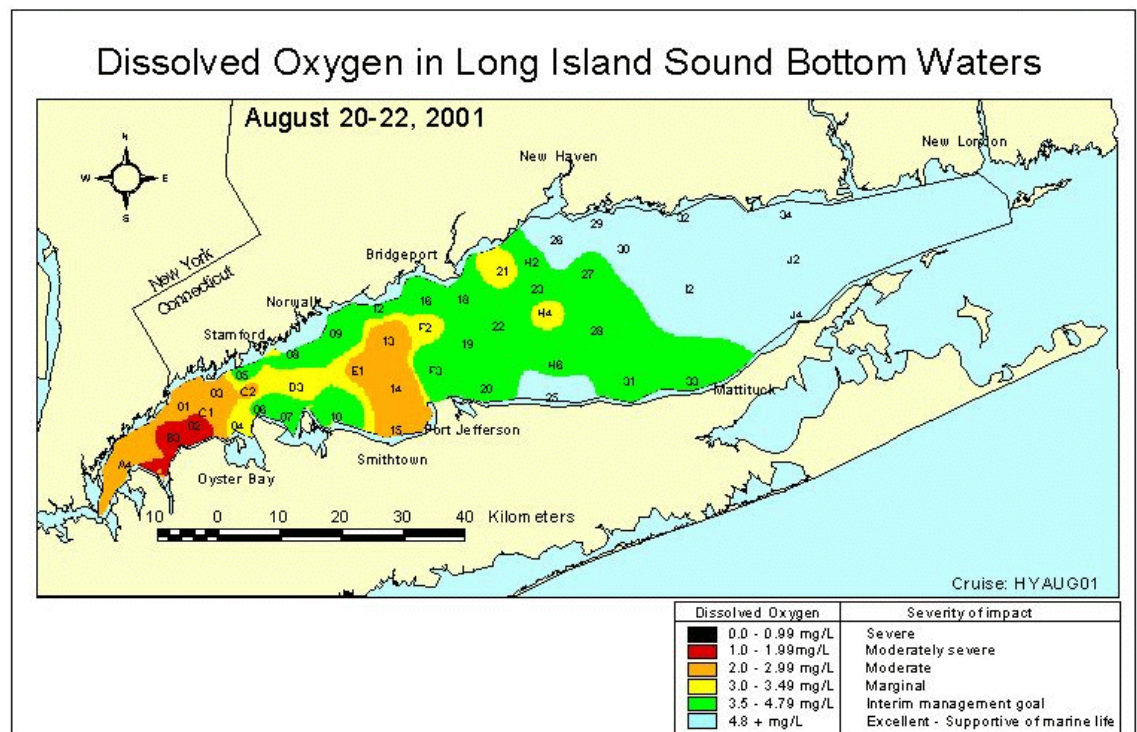


Figure 3

## SUMMARY OF CCMP MANAGEMENT ACTIONS: HYPOXIA

### H-1. REDUCING NITROGEN FROM SEWAGE TREATMENT PLANTS AND OTHER POINT SOURCES (CCMP TABLE 4, P. 32)

**Key Elements:** The states of Connecticut and New York committed to reducing nitrogen loads throughout the Long Island Sound basin using a mixed approach of retrofits, pilot studies and upgrades under existing permitting authorities. With adoption of the TMDL, state requirements to remove nitrogen loads will be formalized and expanded well beyond the commitments specified in the CCMP. In anticipation of TMDL adoption, the states have been using a variety of legal, voluntary, and funding mechanisms to promote nitrogen removal from point sources, with considerable success.

Description	2002 Planned Action
The total estimated point source load to LIS in 2001 is 152,645 lbs./day, a decrease of more than 59,000 lbs/day from 1990 base levels. New York loads totalled 111,413 lbs/day; Connecticut loads totalled 41,232 lbs/day.	Continued emphasis on TMDL targets.
In Connecticut as of December 2001, 23 municipal sewage treatment plants have completed upgrades including nitrogen removal at a cost of over \$280 million. Six municipal STPs currently have initiated over \$71.5 million of upgrades including nitrogen removal. Two municipal STPs have begun designs for upgrades including nutrient removal at costs totalling over \$98 million.	Continue to assist municipalities with upgrades to STPs. Implement the General Permit for Nitrogen Discharges and the Nitrogen Credit Exchange.
In 2001 New York City initiated a program for Advanced Wastewater Treatment Management that will establish operational procedures for operating the City's Water Pollution Control Plants (WPCP) during wet weather during construction projects to maximize nutrient removals. The program will also identify new technologies for nutrient treatment.	Continue program in 2002.
The Village of Great Neck Sewer District and Great Neck Water Pollution Control District (GNWPCD) are conducting an engineering feasibility study to evaluate diversion of current flows outside the Long Island Sound Basin. The study was completed in April 2001. The Report shows that it is technically quite feasible to divert entire flow to the Cedar Creek wastewater treatment plant, which discharges into Atlantic Ocean. The GNWPCD decided that it needed more information before committing to the diversion. A detailed engineering study is underway to ascertain costs and more detailed design work.	The engineering study is currently underway and should be completed by the end of 2002 the latest.
Belgrave Sewer District, with assistance of \$110,000 in 2001 Clean Water/Clean Air Bond Act Funds, will install upflow fluidized bed technology to evaluate treatment of effluent from a trickling filter facility. The pilot project is near completion. Preliminary results suggested that the system is producing inconsistent effluent results. The technology is feasible but further testing and refinement appears necessary. The District will most likely consider other alternatives to reduce nitrogen.	
Clean Water/Clean Air Bond Act grants in the following amounts have been provided to the following entities to construct new nitrogen removal facilities:  Glen Cove, \$3.3 million; emergency construction started in 2000. Construction related to nitrogen removal started in 2001. Huntington Sewer District, \$3.24 million (in final Plans and Specs stage) Oyster Bay Sewer District, \$3.7 million (in final design stage) Kings Park Sewer District, \$3.152 million (in Plans and specs stage, SBRs will be used for nitrogen removal) Village of Northport, \$977,50 (finalized Plans and specs, ready to go to bid, construction scheduled to begin in 2002) Town of Huntington, Huntington Sewer District, \$5.682 million (finalized Plans and specs, ready to go to bid, construction scheduled to begin in 2002) Suffolk County DPW, Port Jefferson facility, \$3.048 million (in design stage, will utilize SBRs) NYC \$30.828 million for phase I upgrade of the Hunts Point STP. Port Washington Water Pollution Server District, \$222,000 to convert existing tankage to create nitrification/denitrification zones to demonstrate nitrogen removal at this trickling filter facility (system went into operation in December 2001; the system is currently accepting 1 MGD, biomass is being established)	

Description	2002 Planned Action
<p>NYSDEC, in conjunction with the Office of the New York State Attorney General, and the City of New York Department of Environmental Protection entered into an administrative order-on-consent (the Long Island Sound/Jamaica Bay Order) to improve water quality in Long Island Sound and Jamaica Bay. The order, which NYSDEC and NYCDEP entered into in the context of resolving ongoing litigation between the State and City, requires NYCDEP to upgrade the City's four Upper East River Water Pollution Control Plants – Hunts Point, Wards Island, Tallman Island, and Bowery Bay – that discharge to Long Island Sound, by installing Step-Feed Biological Nitrogen Removal (BNR). These upgrades are designed to make the WPCPs capable of achieving the nitrogen removal requirements of the LIS nitrogen TMDL, which became effective April 2001. The Consent Order requires NYC to achieve secondary treatment by the end of 2007, instead of 2010. The cost of the proposed upgrade is approximately \$1.7 billion, which is approximately \$600 million lower than the estimated cost of the upgrade under the former Newtown Creek Order.</p>	
<p>CTDEP's Municipal Facilities Management Program completed major construction projects to rebuild the Norwalk, Waterbury, Thomaston, and New London Sewage Treatment Plants and to improve water quality in the Norwalk Harbor, Naugatuck River, and Thames River. The effluent discharge from the Watertown Fire District to the Steel Brook was eliminated by diverting it through the new Waterbury plant.</p>	
<p>The CT Legislature passed an Act Concerning Nitrogen Reduction in Long Island Sound in July. The Governor signed the legislation into law that gave DEP authority to establish a General Permit for Nitrogen Discharges and set up a Nitrogen Credit Exchange Program. CTDEP held a series of Public Informational Meetings for the Nitrogen General Permit and Credit Exchange in Connecticut in 2001.</p>	<p>Implement the General Permit and institute the first year of Nitrogen Credit Exchange collection and payments.</p>

## H-2. REDUCING NITROGEN LOADS FROM NON-POINT SOURCES (CCMP TABLE 5, P.34)

**Key Elements:** The states of Connecticut and New York have broad authorities to manage nonpoint sources of pollution and have agreed in the CCMP to emphasize control of nitrogen in ongoing state and federal programs. These include state nonpoint source programs (CWA Sec. 319), the coastal nonpoint source control program (CZARA Sec. 6217), and stormwater permitting programs. Most of the site specific studies and activities identified in the CCMP have been completed. The states have committed to using nonpoint source control programs to begin the difficult task of reducing nonpoint sources of nitrogen and anticipate continuing those efforts as the primary means to meet the reduction goal specified in the TMDL upon adoption. In addition to the regulatory and funding programs, the states have made commitments to promote essential technical assistance and training programs through NRCS and NEMO as well as agency watershed and nonpoint programs that have become widespread since development of the CCMP.

Description	2002 Planned Action
<p>Currently CTDEP is implementing 87 active §319 projects from FY96-2001 grants. Twenty-five new projects were funded under §319 in 2001 and 17 projects were closed out.</p>	
<p>CTDEP completed a §104(b)(3) a Long Island Sound watershed model, similar to that used by the Chesapeake Bay Program, to generally guide nonpoint nitrogen and watershed management. The model: 1) assesses nonpoint source contributions of nitrogen, phosphorus, and carbon to Long Island Sound, and 2) assists CTDEP in managing these nutrients to reduce hypoxia. The final model report was issued in 2001.</p>	
<p>EPA continued to provide staff support to the Norwalk River Watershed Initiative in 2001. Implementation of the Norwalk River Watershed Action Plan is guided by the Norwalk River Watershed Advisory Committee, with representatives from EPA, NRCS, CTDEP, the seven watershed communities, several citizen groups, and area residents. From FY98-01, EPA awarded \$340,000 in CWA§319 funds to support several high priority implementation activities including a watershed coordinator, riparian buffer restoration, stormwater management, road sand/salt reduction, and septic system outreach and education.</p>	
<p>In January 2001, the Westchester County Department of Planning, with six municipalities, under the auspices of Watershed Advisory Committee 4, completed <i>Controlling Polluted Stormwater: A Management Plan for the Sheldrake and Mamaroneck Rivers and Mamaroneck Harbor</i>. The plan recommends actions to control nonpoint source pollution via municipal ordinances and comprehensive plans, streams and wetlands, stormwater management, and outreach and education.</p>	<p>Implement the plan and monitor.</p>

<p>In June 2002 Westchester County completed a project to monitor two of the county's largest tributaries to LIS – Mamaroneck River and Blind Brook. In 2001 the County analyzed the data from the monitoring program and determined nutrient loads to the Sound compared with LIS 3.0 model predictions. The results were presented in a November 2001 report, <i>Applying the Results of the Manhattan College Water Quality Monitoring Program for Lower Westchester County</i>, WCPD0010. The Westchester County Planning Department held a briefing for interested parties in December 2001. Information on the County's LIS watershed efforts may be found on their web page at: <a href="http://www.westchestergov.com/planning">http://www.westchestergov.com/planning</a>.</p>	
<p>In 2001 Governor Rowland signed Executive Order No. 19 to reduce NOx emissions from more than 60 point sources by nearly 30% by 2003.</p>	<p>In 2003, it is expected the regulations will result in the reduction of nitrogen oxide emission by nearly 3,550 tons per year.</p>

### H-3. CONTINUING MANAGEMENT OF HYPOXIA (CCMP TABLE 6, P. 39)

**Key Elements:** The actions specified in the CCMP primarily reference research, monitoring and modeling activities and the use of that information and those tools to improve understanding and management of hypoxia in the Sound. Much progress has been made in this area to provide the scientific basis for the TMDL and the TMDL specifies the implementation steps recommended in the CCMP to control hypoxia. Finally, the action to continue appropriate modeling and research and periodically review management plans is central to the adaptive management approach promoted in the TMDL.

Description	2002 Planned Action
The final TMDL with WLA was completed by the states and submitted to EPA in January 2001. The TMDL outlines a comprehensive adaptive management strategy to reduce nitrogen loads, assess effects and improve estimates of loading. EPA approved the TMDL in April 2001.	Begin implementation of TMDL.
The Management Committee adopted the Systemwide Eutrophication Model (SWEM) as a successor to the LIS 3.0 model. The Model Evaluation Group and agencies met in 2001 to review information and data collected as part of the refinement process.	
CTDEP adopted and EPA approved new DO criteria for saltwater in 2001.	NYSDEC and IEC are reviewing the new DO criteria for modification of their DO standards.
EPA has funded NEIWPCC to coordinate a work group charged with improving estimates of nitrogen loading to the CT River from the states of MA, NH and VT. Work in 2001 included synthesis of existing data on water quality, land use and point source discharges	Recommend monitoring and modeling program to improve estimates.

### H-4. FUNDING TO IMPLEMENT HYPOXIA MANAGEMENT PLANS (CCMP TABLE 7, P. 41)

**Key Elements:** The intentions of the CCMP actions were to fully fund existing nonpoint source (CWA Sec. 319 and CZARA 6217) programs, have states supplement state revolving fund programs, and to appropriate additional federal funds for management, emphasizing the Phase III management efforts incorporated in the TMDL.

Description	2002 Planned Action
From 1996-2001, CT committed \$350 million for sewage treatment plant reconstruction projects that will benefit LIS and estimates that Clean Water Funding will be adequate to finance Phase III upgrade. Total CT funding through 2001 including all completed projects, projects still under construction, and projects still in the design phase totals over \$449 million.	For 2002 it is anticipated that the Bond Commission will continue to award CWF funds toward upgrades to STPs for advanced nitrogen removal.
In 2001 the Bond Commission awarded CT Clean Water Fund (CWF) monies to eleven additional STP design and construction projects to be completed over the next three years. A total of \$119 million of CWF financing was committed to these projects.	

#### H-5. MONITORING AND ASSESSMENT OF HYPOXIA (CCMP TABLE 8, P. 4

**Key Elements:** The CCMP recognized the importance of continuing and expanding monitoring efforts to answer fundamental questions on the health of LIS and to identify trends and changes that may be related to management activities. Most of the recommended monitoring was to be directed towards oxygen and nutrients because of the hypoxia problem in LIS. In addition, several specific monitoring/research projects were listed, most of which were completed shortly after the CCMP was released. Lobsters were identified for special attention because of disease problems that pre-dated the 1999 lobster die-off in Western LIS.

Description	2002 Planned Action
<p>The LISS partners continued ambient monitoring of LIS in 2001. CTDEP continued its ambient monitoring of 48 stations in 2001. NYCDEP performed ambient monitoring of NY waters in western LIS. IEC continued its summer hypoxia monitoring in LIS by collection and weekly measurements of DO, temperature, salinity, chlorophyll a at 21 stations, and at a subset of stations, samples were collected for phytoplankton and <i>Pfiesteria</i> in 2001. IEC made weekly data transmissions to LISO, CTDEP, NYCDEP, NYSDEC, MARINE RESOURCES, CSHH and HydroQual. The IEC Annual Report, released each year on January 24, details all monitoring activities. All data is entered into the EPA database, STORET.</p> <p>CTDEP and NYSDEC participated the EPA's National Coastal Assessment in 2001. In addition to its standard water quality parameters, sediment samples were collected once from half of the fixed (sampling point) stations in LIS.</p>	<p>In the summer of 2002 CT and NY will continue to participate in the National Coastal Assessment by recording usual water quality parameters and collect sediment samples from the other half of the fixed (sampling point) stations in LIS.</p>
<p>Hypoxic conditions in LIS were estimated to have extended for a period of 66 days and to cover a maximum area of 133 square miles compared to the 15 year averages of 56 days and 201 square miles.</p>	<p>Continued ambient monitoring of LIS.</p>
<p>CTDEP revised its water quality criteria for DO in 2001 based on the EPA criteria document, <i>Ambient Aquatic Life Water Quality Criteria for DO (Saltwater): Cape Cod to Cape Hatteras</i>, EPA-822-R-00-012, November 2000.</p>	
<p>The University of Connecticut Department of Marine Sciences at Avery Point, Connecticut, continued to operate and maintain its real-time water quality monitoring network, MYSOUND through a 2001 LISS grant and EPA grants under the EMPACT (Environmental Monitoring for Public Access and Community Tracking) program. The five MYSOUND monitoring stations are located in: 1) the Western Sound, maintained by the Indian Harbor Yacht Club; 2) Hempstead Harbor, maintained by the Coalition to Save Hempstead Harbor; 3) Bridgeport Inner Harbor; 4) Lower Thames River; and 5) Eastern Sound Offshore. The MYSOUND stations monitor surface and bottom waters for dissolved oxygen, temperature, salinity and selected other parameters at specific sites. The MYSOUND website address is: <a href="http://www.mysound.uconn.edu">http://www.mysound.uconn.edu</a>.</p>	<p>Continued operation of the fixed monitoring stations through 2002.</p>
<p>In 2001, the LISS funded 3 research projects to study nutrient and phytoplankton dynamics in LIS: 1) isotope tracers of nitrogen in Western LIS (PI- Dr. Fairbanks, Columbia U.); 2) phytoplankton dynamics in LIS (PI- Dr. Ward, UCONN); 3) water column O<sub>2</sub> production and consumption in LIS (PI- Dr. Kremer, UCONN).</p>	<p>These projects will begin in 2002 and extend through 2003.</p>